Biomass Program

Thermochemical R&D

Refractory for Black Liquor Gasifiers

Black liquor can be highly corrosive and process equipment such as the reactor vessel, heat exchanger tubes, and hot-gas filters must be resistant to the severe thermal and chemical process conditions. The primary objective of this research is to develop cost-effective materials to address the material challenges presented by black liquor gasification.

Researchers will investigate and analyze various refractory materials to determine how well they perform in the severe gasifier operating environment. Emphasis will be placed on functional properties, longevity and stability of materials, and economics.

R&D Pathway

Refractory materials will be selected based on their capability to meet at least one of these criteria: (1) ability to react with the gasifier environment to form protective surfaces in-situ; (2) functionally-graded to give the best combination of thermal, mechanical, and physical properties and chemical stability; or (3) relatively inexpensive, reliable materials.

Material property analyses will be conducted on the selected materials. This includes microstructural and phase analysis, measurement of bulk physical properties for comparison of corrosion resistance, and measurements of both the contact angle between the refractory and the smelt and the depth of smelt penetration at elevated temperatures. Satisfactory materials will undergo testing in an industry facility.

Finite element models will be developed to analyze heat flow and thermal stress/strain in the refractory lining and steel shell of existing and proposed vessel designs. The model will provide for the optimization of geometry, selection of the most cost-effective refractory, and estimation of the expected lifetime.

Benefits

- **Increased reliability of black liquor gasification systems**

Applications

Improved refractory materials for black liquor gasifiers will increase system reliability and contribute to greater economic viability of the process.

Project Partners

University of Missouri-Rolla

Project Period

FY 2003 – FY 2004

For more information contact:

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